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UNITED STATES PATENT APPLICATION

FOR

**ESD System For Grounding
Electronics Within An Enclosure**

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ESD SYSTEM FOR GROUNDING
ELECTRONICS WITHIN AN ENCLOSURE

5 Inventor:
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CROSS REFERENCE TO RELATED APPLICATION

The present application claims the benefit under 35 U.S.C. §119(e) of
10 United States Provisional Patent Application Serial No. 60/457,737, filed
March 25, 2003.

BACKGROUND OF THE INVENTION

Field of the Invention

15 This invention relates generally to the field of enclosures for housing
electronics, and in particular to a system for dissipating static electric charge
from electronics on a circuit board as the board is inserted into the enclosure.

Description of the Related Art

20 Enclosures for housing electronic circuit boards are widely used in a
variety of technologies, including telecommunications, industrial control,
medical electronics, and military applications. Such enclosures are provided
with guides so that individual circuit boards can be slid in or out of the
enclosure, and a backplane through which the circuit boards may be
25 electrically connected to other electronic components. Each circuit board is
electronically connected to the backplane through engagement of pins
projecting from the backplane with connectors attached to the circuit boards.

When a circuit board is inserted in an enclosure, static from the technician may be discharged onto the circuit board. It is important that this static be discharged from the circuit board prior to the connectors of the circuit board making contact with the pins of the backplane. Otherwise, the static will travel through the backplane pins toward electronic components connected to those pins and may damage those components.

In electronics systems, many devices and techniques have been developed to provide electrostatic discharge (ESD) protection and to provide electromagnetic containment (EMC) or electromagnetic interference (EMI) shielding. These devices and techniques include those disclosed in the following references, each of which is incorporated by reference in its entirety herein:

- U.S. Patent No. 3,835,438, issued September 10, 1974 to Longworth, Jr., entitled "Self-Grounding Clip For The Mounting Strap Of An Electric Switch Or Receptacle";
- U.S. Patent No. 4,781,603, issued November 1, 1988 to Olsson et al., entitled "Grounding System For A Cabinet";
- U.S. Patent No. 5,196,712, issued March 23, 1993 to Nguyen et al., entitled "Printed Circuit Board Apparatus With Optical Switching";
- U.S. Patent No. 5,311,408, issued May 10, 1994 to Ferchau et al., entitled "Electronic Assembly With Improved Grounding And EMI Shielding";

- U.S. Patent No. 5,478,253, issued December 26, 1995 to Biechler et al., entitled "Electrostatic Discharge Contacts For Blind Mating Connectors";
- 5 • U.S. Patent No. 5,537,294, issued July 16, 1996 to Siwinski, entitled "Printed Circuit Card Having A Contact Clip For Grounding A Printed Circuit Board Found Therein";
- U.S. Patent No. 5,867,366, issued February 2, 1999 to Klein et al., entitled "Electronic Module And Plastic Substrate To Accept And Hold The Electronic Module";
- 10 • U.S. Patent No. 5,916,652, issued June 29, 1999 to Miner et al., entitled "Liner For Adhesive-Backed Sheet Material";
- U.S. Patent No. 5,934,916, issued August 10, 1999 to Latal et al., entitled "Printed Circuit Board Mounting Rail Member And Ground Clip Assembly";
- 15 • U.S. Patent No. 5,973,926, issued October 26, 1999 to Sacherman et al., entitled "Method And Apparatus For Attaching Circuit Board To Chassis And Forming Solid Ground Connection Using A Single Crew";
- U.S. Patent No. 6,080,930, issued June 27, 2000 to Lommen et al., entitled "ESD/EMC Gasket";
- 20 • U.S. Patent No. 6,159,024, issued December 12, 2000 to Munch et al., entitled "Device For Creating An Electrically Conducting Connection For An Assembly Panel Fitted In A Switch Cabinet";

- U.S. Patent No. 6,201,710, issued March 13, 2001 to Bagung et al.,
entitled "Housing Configuration For A Printed Circuit Board Equipped
With Components";
- 5 • U.S. Patent No. 6,254,402, issued July 3, 2001 to Barnes, Jr. et al.,
entitled "Push Pin Ground";
- U.S. Patent No. 6,276,947, issued August 21, 2001 to Homfeldt et al.,
entitled "U-Crimp";
- U.S. Patent No. 6,282,101, issued August 28, 2001 to Hanas et al.,
entitled "EMI/ESD Shielding Assembly For An Electronic System";
- 10 • U.S. Patent No. 6,301,124, issued October 9, 2001 to Nikazm et al.,
entitled "Computer Chassis Identification Method"; and
- U.S. Patent No. 6,483,023, issued November 19, 2002 to Jacques,
entitled "Fabric Wrapped Over Spring EMI Gasket".

15 Referring first to Fig. 6, which is a prior art representation of a portion of
a printed circuit board 10 being inserted into a conventional enclosure 11.
The circuit board 10 may conventionally include ground pins 12 beneath the
printed circuit board which fit into receptacles 13 formed through a bottom
bracket 16 across the front face of the enclosure. Typically, the bottom
20 receptacles are circular openings sized so that the ground pin 12 at the
bottom of the printed circuit board engages the sides of the receptacles 13
prior to the circuit board connectors engaging the backplane pins so that any
charge on the circuit boards passes from the pins to the brackets as a result

of contact with the sides of the receptacles. The brackets are in turn grounded through the housing of the enclosure.

A problem of the above solution is that the pins must be aligned to the receptacles within a relatively tight tolerance. If the pins do not align properly
5 within the receptacles (for example due to faulty manufacturing or a ground pin being bent), the pins may butt up against the bracket and prevent the circuit board from being inserted into the enclosure. This problem is exacerbated in that typical enclosures may have slots for sixteen or more circuit boards, each having a separate ground pin which must align and be
10 properly received within its respective receptacle. Other conventional enclosures house even more circuit boards.

Even where the pins do fit within the receptacles, there is not always good electrical contact, resulting either in charge being retained on the boards, or charge having to travel across a relatively small contact area
15 between pin and receptacle, thus resulting in high resistances and heat generation.

Referring still to prior art Fig. 6, the enclosure typically includes a second receptacle 15 mounted in a top bracket 14 for receiving an alignment pin 17 on the top portion of the circuit board 10. Owing to the difficulty in
20 aligning both bottom pin 12 and top pin 17 within respective bottom and top receptacles 13 and 15, the top receptacle 15 is typically oblong in shape. (The positions of circular receptacle 13 and oblong receptacle 15 are occasionally switched so that the oblong receptacle 15 is provided in the bottom bracket 16). Due to the oblong shape of receptacle 15, the top pin 17 and receptacle

15 are ineffective as a ground path for the discharge of static electricity from the circuit board 10.

SUMMARY OF THE INVENTION

5 The present invention relates to a system for dissipating static electric charge from electronics on a circuit board as the board is inserted into an enclosure. The enclosure includes one or two conductive gaskets mounted on a flange affixed across a front side of the enclosure and having a path to ground through the enclosure. The gaskets are mounted so as to receive a
10 ground pin extending from the circuit board as the circuit board is inserted into the enclosure. The pin has a length so that the pin contacts the dissipative gaskets prior to any electrical connection of the contacts on the circuit board and pins on the backplane.

 The use of gaskets in accordance with the present invention provides
15 greater tolerances and greater surface area of contact (thus reducing impedance and heat generation) between the pin and conductive gasket as compared to prior art systems.

BRIEF DESCRIPTION OF THE DRAWINGS

20 The present invention will now be described with reference to the drawings in which:

 FIGURE 1 is a perspective view of an enclosure including ESD dissipative gaskets according to the present invention for dissipating charge from circuit boards housed within the enclosure;

FIGURE 2 is a perspective view within the interior of the enclosure showing a circuit board being inserted into the enclosure;

FIGURE 3 is an enlarged perspective view of an enclosure according to the present invention showing a ground pin being inserted into engagement
5 with a single gasket for dissipating charge from circuit boards housed within the enclosure;

FIGURE 4 is an enlarged perspective view of an enclosure according to the present invention showing a ground pin fully inserted into engagement with a single gasket for dissipating charge from circuit boards housed within
10 the enclosure;

FIGURE 5 is an enlarged perspective view of an enclosure according to an alternative embodiment of the present invention including a pair of opposed gaskets for dissipating charge from circuit boards housed within the enclosure;

15 FIGURE 6 is a prior art partial perspective view of a conventional electronics enclosure and printed circuit board fitting therein and having a ground pin and an alignment pin.

DETAILED DESCRIPTION

20 Embodiments of the present invention will now be described with reference to Figs. 1-5, which relate to a system for dissipating static electric charge from electronics on a circuit board as the board is inserted into an enclosure. While the enclosure may be used in technologies such as telecommunications, industrial control, medical electronics, and military

applications, it is understood that the present invention is not limited to enclosures for such technologies, and may be used in enclosures intended for a variety of other technologies and applications.

Moreover, it is understood that the present invention may be embodied
5 in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the invention to those skilled in the art. Indeed, the invention is intended to cover alternatives, modifications and equivalents of these embodiments, which are
10 included within the scope and spirit of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be clear to those of ordinary skill in the art that the present invention may be practiced
15 without such specific details.

Referring now to Fig. 1, there is shown an enclosure 20 for housing a plurality of circuit boards 22 in parallel relation to each other (one such circuit board 22 being shown in Fig. 1). At least portions of the enclosure 20 are electrically conductive, typically made of metal or conductive plastic, such as
20 conductive ABS, providing a path to ground. The circuit boards 22 are inserted through a front surface 23 of the enclosure 20. A rear surface (not shown) of each circuit board 22 has connectors (not shown) for engagement with pins protruding from a backplane (not shown) on a rear surface of the enclosure 20.

Referring to Figs. 2 through 4, circuit boards 22 typically include ground pins 26 for grounding the circuit boards 22. The enclosure 20 includes a top flange 28 and a bottom flange 30 adjacent to the front surface 23, across a top and bottom portion of the front surface 23. In accordance with a first embodiment of the present invention, a conductive, elastic gasket 32 is affixed to each of the top and bottom flanges 28, 30. As shown in Figs. 2 and 3, as the circuit boards are inserted into the front surface 23 of enclosure 20, the ground pin 26 at the top of the circuit board engages the gasket 32 mounted on the top flange 28, and the ground pin 26 at the bottom of the circuit board engages the gasket 32 mounted on the bottom flange 30 (Figs. 3 and 4 show only the engagement of the pin 26 with the gasket 32 on the bottom flange 30). It is understood that the gasket 32 on either the top flange 28 or bottom flange 30 may be omitted in alternative embodiments so that the enclosure 20 includes only a single gasket that is engaged by the ground pin 26 at either the top or bottom of the circuit board.

Each of the gaskets 32 is preferably of known construction, such as for example any of various gaskets manufactured by Laird Technologies, P.O. Box 650, Shielding Way, Delaware Water Gap, PA 18327. They may be formed of a flexible, spring-like material which is conductive, or is coated with a conductive material, for example, beryllium copper, stainless steel or nylon with metallic threads. The spring-like material is elastic in that it deforms upon engagement with a ground pin, but then returns to its original shape when the engagement with the ground pin ends. The gaskets may be affixed to the flanges 28 and/or 30 by conventional means such as a conductive or non-

conductive adhesive, screws or rivets. Alternatively, they may be formed so as to clip onto flanges 28 and/or 30. In a preferred embodiment, the gaskets 32 on the upper flange 28 and/or lower flange 30 preferably have a length across the front surface 23 of the enclosure 20 sufficient so that the ground
5 pins 26 on each of the circuit boards inserted into the enclosure 20 engage the gasket 32 on the upper flange 28 and/or lower flange 30.

The gaskets 32 include a surface for engaging the ground pin 26 which is convex and which is deformed by the ground pin upon engagement therewith when the circuit board 22 is inserted into the enclosure 20. While
10 gaskets 32 may be used in preferred embodiments, it is understood that other conductive and deformable materials may be affixed to flanges 28 and/or 30 to provide a tolerant ESD engagement with ground pins 26 upon insertion of the circuit boards 22 into enclosure 20. Such alternatives include a metallic mesh or a deformable polymer or rubber which is conductive or is coated with
15 an electrically conductive material and mounted to flanges 28 and/or 30. Other known alternatives are contemplated.

In operation, upon insertion of a circuit board 22 into enclosure 20, prior to engagement between the circuit board contacts and the backplane pins, the ground pins 26 engage the gasket 32 mounted on the top flange 28
20 and/or on the bottom flange 30. Any charge on the circuit board dissipates through ground pins 26 to gasket(s) 32, and from gasket(s) 32 to the flanges 28/30. The flanges are in turn grounded through the enclosure.

The gasket(s) 32 provide a tolerant solution to dissipating charge from the circuit board 22 through the ground pins 26. Unlike the prior art

receptacles, precise alignment between the gasket and ground pin is not required. For example, where the vertical alignment of the ground pin 26 is higher than expected relative to the enclosure, the ground pin still engages the gasket, but does not deform or compress it significantly. Alternatively,

5 where the vertical alignment of the ground pin 26 is lower than expected relative to the enclosure, the ground pin engages the gasket and significantly deforms or compresses it. In this way, the vertical alignment of the ground pin may vary 1/16 inch to 1/8 inch above or below the expected vertical position within the enclosure and still establish a good electrical connection with the

10 gasket for discharging static buildup. It is unlikely that the misalignment between the ground pin and enclosure would be greater than 1/8 inch. However, it is understood that in applications where larger misalignments may occur, gaskets according to the present invention may be provided in which the vertical alignment of the ground pin may vary greater than 1/8 inch, for

15 example 1/4 inch, above or below the expected vertical position within the enclosure and still establish a good electrical connection with the gasket for discharging static buildup.

Moreover, the deformation of the gasket upon contact by the ground pin allows a large area of contact between the gasket and ground pin. The

20 large area of contact between the gasket and ground pin allows efficient dissipation of charge from the circuit boards without generating excessive heat at the interface. In one embodiment, each gasket is able to dissipate 25 amps from each circuit board through the ground pin. It is understood that the gaskets may be capable of dissipating more or less charge than that in

alternative embodiments. Further still, gaskets 32 may be purchased off the shelf, and a single gasket may be used to dissipate charge from the entire set of circuit boards inserted into enclosure 20.

Up to this point, the ground pins 26 at the top and bottom of the circuit board 22 engage a single gasket 32. However, in an alternative embodiment shown in Fig. 5, the ground pins 26 (not shown in Fig. 5) may engage a first gasket 32 mounted on a bottom portion of flange 28 and/or 30, and a second gasket 32 mounted on a top portion of flange 28 and/or 30. Thus, upon insertion of the circuit board 22, the ground pin 26 engages and deforms both gaskets 32 on the bottom and top portions of the flanges 28 and/or 30.

It is understood that the gasket 32 described in each of the embodiments shown in Figs. 1-5, and the use of gasket 32 in accordance with the present invention, complies with and allows compliance with all applicable standards, including the Advanced Telecom Computing Architecture (ATCA) PICMG 3.0 Short Form Specification, which specification is incorporated by reference herein in its entirety.

As indicated in the Background of the Invention section, conventional enclosures included a second receptacle for receiving an alignment pin also provided on the circuit board. However, owing to the difficulty in aligning both the top and bottom pins within respective top and bottom receptacles, the top receptacle is typically oblong in shape. Thus, the top pin and receptacle are ineffective in conventional designs as a ground path for the discharge of static electricity from the circuit board. However, in accordance with a further aspect of the present invention, the gasket(s) 32 remove the requirement for

accurate alignment of the pins and receptacles and allow the upper pin to also engage one or two gaskets mounted adjacent the lower bracket, thus establishing a redundant ground path to the ground path provided by the upper ground pin and gasket(s) as explained above. The redundant ground path ensures that static is discharged from the circuit board in the event of a defect in the ground path established by the lower ground pin and gasket(s). Additionally, the redundant ground path established by the upper ground pin and gasket(s) provides even more surface area over which charge may be dissipated from the circuit board. It is understood that either the top or bottom pin on the circuit board may be considered to establish the redundant ground path.

Although the invention has been described in detail herein, it should be understood that the invention is not limited to the embodiments herein disclosed. Various changes, substitutions and modifications may be made to the disclosure by those skilled in the art without departing from the spirit or scope of the invention.